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(54) METHOD FOR AUTOMATIC DEBITING OF TOLLS FOR VEHICLES

VERFAHREN ZUM AUTOMATISCHEN ABBUCHEN VON MAUTGEBÜHREN FÜR FAHRZEUGE

PROCEDE POUR DEBITER AUTOMATIQUEMENT DES FRAIS DE PEAGE RELATIFS A DES VEHICULES

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Description

TECHNICAL FIELD

[0001] The invention presented here concerns a method for the automatic debiting of a toll for a vehicle that uses a zone or zones that are equipped with tolls at the entry to these zones. In this invention a distinction is made between virtual toll stations and physical toll stations, where a toll debiting transaction is carried out at the virtual station, indicated by using a global satellite navigation system, by means of a communication device fitted to the vehicle which communicates, via a digital mobile transmitting network, with the toll debiting system's central system and exchanges information with the central system. At the physical station, the information is then checked so as to determine if a correct debiting of the toll for the vehicle has been performed or if debiting is to be carried out afterwards.

STATE OF THE ART

[0002] Automatic stations for debiting of tolls with a variety of designs are known. The document PCT/DE95/00107 (WO-A-9 520 801) describes an example of a toll debiting system of a type mentioned in the introduction. The said document describes a system for debiting of tolls that comprises at least one virtual toll charging station on the traffic route, and in association with the toll charging station a monitoring station, which is physical. A physical toll station is equipped with hardware such as communication units and imaging devices, for example video cameras. A vehicle that is in the virtual toll charging station is able to transmit data via a digital mobile transmitting network to a central unit The virtual toll charging stations are defined at predetermined geographic positions. Aided by a GPS system (Global Positioning System), the position of the vehicle is determined continuously and is compared with the positions of the virtual toll charging stations. If the position of the vehicle coincides with any of the predetermined virtual toll charging stations, it is indicated by the equipment in the vehicle, after which the vehicle establishes communication via the digital mobile transmitting network. Data which includes toll and charge accounts is transmitted from the vehicle to the central unit. Receipt of payment for the requisite amount is then sent from the central unit to the physical station. The advantage of this technique is that preexisting infrastructure can be utilized, both in this GPS system and in the GSM technique for the digital mobile transmitting network. However, investments in roadside equipment will be required. A further very important advantage is that sufficient time can be allowed for data information exchange between the vehicles equipment and the central unit, so that all transmission can be achieved without capacity problems in computer power or communication. This normally presents difficulties when all the information in existing systems is transmitted within an area consisting of the communication zone of one physical toll station. Moreover, using this method it is possible to separate, both in time and space, debiting of tolls and monitoring of correct payment of charges by vehicles.

[0003] A drawback associated with the device described in PCT/DE95/00 107 (WO-A-9 520 801) is that the receipt of payment is sent from the central unit to the physical toll station, which means that large amounts of data have to be sent out and be accessible at each physical toll station within a specified area, since at the point of time of payment it is not clear which physical toll station will be subsequently passed. In addition large storage and search capacities are required for computers in the physical toll station. There is no direct communication between the vehicle and the physical toll station, which means that correlation between the identity of the vehicle and receipt is missing.

[0004] Document PCT/GB95/00198 (WO-A-9 521 424) describes a further example of a device for automatic debiting of tolls for vehicles where GSM technique is used. In the said document the emphasis is on performing debiting of tolls while preserving the anonymity of the vehicle. This is achieved by means of a vehicle identifier, fitted to the toll charging station, which identifies a communication device on the vehicle or identifies a vehicle carrying an electronic purse designed for debiting of tolls. The system is also provided with devices that temporarily correlate the vehicle identifier with an identifier for the electronic purse. Furthermore, the system is designed in such a way that the vehicle identifier is not used if the toll debiting transaction is correctly carried out, or that the purse identifier is not used if the toll debiting transaction is not executed satisfactorily. The document also states that the communication device may be a GSM transmitter/receiver. However, there is no description of any type of virtual debiting system. This implies that with this method it is not possible to carry out a toll debiting transaction in advance or to assign the respective vehicles a receipt for payment made before the physical toll station is passed. Hence, the requirement that all communication and identification of the various units must be performed during the time that is available, that is to say, when the vehicle is in the area of the physical toll station. As a result of the lack of time a problem arises, namely that during the short time available manage to identify the vehicles, execute the transaction and also track vehicles for which a correct debit transaction cannot be carried out, so that these can be debited afterwards.

[0005] Document WO 95/20801 discloses determining toll charges for traffic routes and areas, toll charges being calculated with the aid of a device installed in a vehicle on the basis of positional and tariff data. The data is then transmitted via a data transmission system to a central point, with the possibility of verification of the appropriate charge. A drawback of this approach is the difficulty of establishing a correlation between the data

transmitted and vehides in the system.

DESCRIPTION OF THE INVENTION

[0006] According to an aspect of the present invention, a method for automatic debiting of tolls for vehicles, as specified in claim 1 is set out.

[0007] An advantage of the invention over the known technique is that the digital mobile transmitting network is not loaded to the same extent as for the most closely related technique known. A further advantage is that the same storage and search capacities are not required in the storage units in the physical toll station as with the related known technique described in the introduction.

DESCRIPTION OF FIGURES

[0008]

Figure 1 illustrates schematically the principle of debiting of tolls according to the aspect of the invention.

Figure 2 shows an example of a configuration of units in vehicles, physical toll station and the central unit of the toll debiting system.

DESCRIPTION OF EMBODIMENTS

[0009] A number of different embodiments of the invention are described below with the aid of the figures.

[0010] Automatic debiting of tolls for admission of a vehicle to a traffic route or traffic zone requires a supervision system. According to a form of execution of the method and the device for automatic debiting of tolls for vehicles, the supervising device comprises vehicle equipment and a roadside unit. The vehicle equipment comprises:

- a first communication device (1) in the vehicle V1-V4 for local communication (2) with a roadside unit (3) at a physical toll station (4). The first communication device (1) may consist of a transponder for the local communication (2) by means of microwaves, or analogous devices which utilize transmission media other than microwaves, such as ultrasound, light inductive transmission etc. DSRC (Dedicated Short Range Communication), where microwaves are used as the transmission medium, is preferred. Other sources that can be used as transmission media for the local communication link (2) between vehicles V1-V4 and the roadside unit (3) are UWB waves (Ultra Wide Band radio), ultrasound, infrared light, laser or ordinary (visible) light,
- a first processor (5) for calculation and/or subtraction of tolls and for guiding the communication between the vehicle's inner units and the outside world,
- a storage unit (6) for storage of data, such as user identity, positions of virtual toll charging stations (7), tariffs, etc for calculation of said tolls. The user identity may consist of the vehicle identity, the purse identity or the transponder identity,
- a receiver for GNSS (Global Navigation Satellite System), which may consist of a GPS receiver (8) for reception(9) of signals from navigation satellites (10),
- a transmitter/receiver in a cellular network, CN, usually in the form of a GSM telephone (11), for a central communication (12) with a central unit (C) in the toll debiting system

in addition to, preferably,

- a reader (13) for reading and debiting of smart cards, where a suitable CN unit and reader (13) are integrated in a mobile telephone (15) and that
- these said units in the vehicle communicate between one another using an existing vehicle LAN where communication is via CAN data bus or via ITS bus or via appropriate interfaces (or cables).

[0011] The physical toll station (4) comprises

- a roadside unit (3) which has a second communication device (16) for the local communication (2) with a first communication device (1) in one of the aforesaid vehicles V1-V4. The use of DSRC (Dedicated Short Range Communication), where microwaves are utilized as the transmission medium, is preferred. Other sources that can be used as transmission media for the local communication link (2) between vehicles V1-V4 and the roadside unit (3) are UWB waves (Ultra Wide Band radio), ultrasound, infrared light, laser or ordinary light,
- video equipment (17a-17c) as well as suitable lighting equipment for reproduction of characteristic features of the vehicle V1-V4, such as the number plate, and for detection of the vehicle's physical shape, including necessary image processing equipment (18) with OCR functionality (Optical Character Recognition) for identification of registration number or equivalent features,
- a second processor (19) in the roadside unit (3) for determination of the position of the vehicles V3 and V4 within the physical toll station, based on information from measurements with the aid of

  a) the local communication (2) between the first communication device (1) in the vehicle V3, V4 and the second communication device (16) in the roadside unit (3),
  b) information from the image processing equipment (18) as well as
  c) correlation of the positions obtained from measurements carried out with the help of both

communication devices (1, 16) and information from the image processing equipment (18),

- a storage unit (20) in the roadside unit (3) for storage of data relating to positions obtained by the local communication (2) between the first (1) and the second (16) communication device,
- equipment (21) in the roadside unit (3) suitable for transmission (22) of registered data to the central unit (for instance,by GSM, WAN or via optical fibre networks) and
- encrypting equipment for encrypted transmission of data between physical toll station (4) and central unit C.

[0012] Encryption in this text includes the notion that the message can be encrypted so as to prevent eavesdropping, but the term encryption is also or alternatively used to mean authenticization, that is to say that to the encrypted message is attached a check total or a digital signature which is used to verify that the message has not been garbled and to verify that the sender is the one stated.

[0013] Apart from the above mentioned units, it is assumed that the central unit C includes the necessary equipment in the form of a third processor (23), a central storage unit (24), a SAM (Security Application Module) (25), communication equipment (26) for the central communication (12) with the vehicles' GSM telephones (11) and with the physical toll station's communication equipment (21), from where transmission (22) of data from the roadside unit (3) to the central unit is effected.

[0014] The toll debiting procedure proceeds as follows:

[0015] In the vehicle's storage unit is the necessary Information, such as tariffs for debiting of tolls and positions of virtual toll charging stations (7,) either prestored or continuously updated via, for example, the GSM network or the RDS-TMC link (Radio Data System - Traffic Message Channel) or alternatively via microwave transmitters or their equivalent.

[0016] By way of the vehicle's GPS receiver (8) (or another GNSS receiver) information on the vehicle's position is obtained continuously. When the position of the vehicle coincides with the position of one of the virtual toll charging stations (7), the position of which is stored in the vehicle's storage unit (6), as shown in figure I for vehicle V2, the central unit C is contacted from the vehicle's GSM telephone (11) (or another transmitter/ receiver in a cellular network). The determined virtual toll debiting position is located at an appropriate distance before a physical toll station (4) that will subsequently be passed by the vehicle. In the virtual toll charging station (7) the vehicle V1-V4 is debited a toll via, in this example, the GSM network. An encrypted signal is sent from the vehicle V1-V4 to the central unit C with information on at least one transponder identity and a statement of the time. A payment transaction is subsequently carried out by means of the central unit's C processor, which debits a prepaid account associated with the transponder identity or deducts the toll in question based on stored tariffs, in the vehicle's storage unit (6), from a smart card in the vehicle which can communicate via the GSM network. The toll is calculated by the vehicle's processor (5). Alternatively, it is possible to send, from the vehicle, the vehicle identity instead of the transponder identity.

[0017] In the vehicle V2 there should be equipment (e.g. MMI) which informs the driver that he has entered a geographically defined zone which consist of a virtual toll charging station (7), and indicates that payment of the toll is to be made. The advantages of this are that the driver is not charged without his knowledge, that it is possible for the driver to decide on the method of payment, for example by means of an account or with a smart card, and lastly that the smart card does not need to be in the reader constantly.

[0018] When the central unit's processor (23) registers that the vehicle has correctly paid the toll In question, confirmation, in encrypted form, is sent back via the GSM network as a receipt that the vehicle V1-V4 carrying the specific transponder identity has been debited with a toll of a certain sum. This means that the vehicle itself carries a receipt that the toll has already been paid before the vehicle V1-V4 drives into a subsequent physical toll station's (4) field. With this procedure the only measure necessary at the physical toll station (4) is to verify that the passing vehicle is debited with a toll which corresponds to the category of the vehicle.

[0019] When the vehicle reaches the physical toll station (4) a encrypted signal is sent from the vehicle's communication device (1) to the roadside unit's (3) communication device (16), either at the request of the roadside unit's equipment which includes a transmitter, or continuously within a time interval during which communication (2) can proceed owing to the fact that the range for communication is limited. The signal consists of an encrypted message containing data on the transponder identity, receipt of payment, and preferably information on the category of the vehicle. The last mentioned information can then be used to permit the toll station's (4) video equipment (17a-17c) to check the category of the vehicle. The passage of the vehicle V 1-V4 through the physical toll station (4) is monitored using video supervision, by the imaging of the vehicle's identity such as the vehicle's licence plate or other physical feature, and even by detection of the vehicle's physical shape so as to check the category of vehicle given by the vehicle via the communication link (2) between vehicle V1-V4 and roadside unit (3) as just described. An alternative procedure is to merely image the vehicles for which a correct receipt of toll payment cannot be registered.

[0020] Communication between vehicle V1-V4 and the roadside unit (3) contain an input of the vehicle's positions. Analogous position detection is even performed with the help of image processing of the results from vid-

eo supervision using image processing equipment (18) which communicates with the roadside unit's (3) processor (1) for analysis. By correlating the input positions derived partly from the said communication (2) between vehicle and roadside unit, and partly from the positions determined by the video supervision, with each other, communication (2) with a specific vehicle V1-V4 is linked to the vehicle imaged by the video supervision. This correlation is, with todays technique, highly desirable, as it is not yet possible to maintain a one hundred percent identification of registration numbers by video supervision nor to achieve a one hundred percent functioning of vehicle / roadside communication. If this were possible it would be sufficient to correlate registration number indicated by the vehicle / roadside communication (2) with the registration numbers identified by video supervision. Correlation is desirable in order to avoid the risk of, for example, prohibited manipulation of vehicle data stored in the vehicle equipment.

[0021] If it is impossible to link correct debiting of a specific vehicle to a specific video registration, the imaging of that vehicle together with the transponder identity, and a statement of the time and zone is sent to the central unit as a basis for subsequent debiting of a toll. If a correct debiting operation is executed, then images and other information memorized in the roadside unit's memory is erased so as to preserve the integrity of the users.

[0022] In the proposed example microwave communication is used between vehicles V1-V4 and roadside unit (3).

[0023] An advantage of the described system in comparison with those known at present is that it allows sufficient time for communication of transaction data of varying length. As a result of this, other data can without difficulty be transmitted between the first and the second communication devices during the brief time the microwave link, according to our example, is connected within the physical toll station (4). Furthermore, local image processing of the registered vehicles places only small demands and loads on the communication network between the roadside unit (3) and the central unit C.

[0024] An additional advantage of the proposed technique according to the aspect of the invention is that it allows automatic debiting of tolls on multi-lane roads, as well as enabling debiting and execution of the payment transactions to be performed in real time, which contributes to increased anonymity for the users in the system.

Claims

1. A method for automatic debiting of tolls for vehicles (V1-V4) on traffic routes or in traffic zones, where at least one virtual toll charging station (7) is geographically predetermined in relation to a physical toll station (4), where a respective vehicle (V1-V4) is equipped with vehicle equipment, said vehicle equipment comprising

   - a first communication device (1) for communication with a roadside unit (3) at said physical toll station (4);
   - a transmitter/receiver (11) for communication (12) via a cellular network with a central unit (C); and
   - a first processor (5), a storage unit (6) and a receiver (8) for a GNSS system;

   whereby

   - the receiver (8) supplies signals from which the first processor (5) reads the position of the vehicle (V1-V4) and detects the entry of the vehicle into the at least one virtual toll charging station (7) by comparing the read vehicle position to the positions of the virtual toll charging stations, data on which are stored in the storage unit (6);
   - upon entry of the vehicle (V1-V4) into the at least one virtual toll charging station (7) the transmitter/receiver (11) announces, via a cellular network, to the central unit (C) that a toll debiting transaction is to be executed;
   - the central unit (C) carries out the toll debiting transaction for the vehicle (V1-V4);
   - central unit (C) returns a receipt of the transaction to the vehicle by its transmitter/receiver (11);
   - upon entry into the physical toll charging station (4), the first communication device (1) sends to the roadside unit (3), the receipt as proof that the correct toll has been paid.

2. A method according to claim 1, **characterized in that** in connection with the toll debiting transaction at least one transponder identity and a statement of the time is sent from the vehicle (V1-V4) to the central unit (3).

3. A method according to claim 2, **characterized in that** in connection with the toll debiting transaction the central unit (C) debits a transponder identity associated device containing a sum of money.

4. A method according to claim 1, **characterized in that** in connection with the toll debiting transaction at least one vehicle identity or purse identity and a statement of the time are sent from the vehicle to the central unit (C).

5. A method according to claim 4, **characterized in that** in connection with the toll debiting transaction the central unit (C) debits a device associated with the vehicle identity or the purse identity, and containing a sum of money.

6. A method according to claims 1-5, **characterized in that** the receipt which is sent from the central unit (C) to the vehicle (V1-V4) for storage in the vehicle equipment's storage unit (6) contains data that identifies the vehicle as well as data on the charge debited to the vehicle.

7. A method according to claim 6, **characterized in that** the receipt which is sent from the vehicle (V1-V4) to a second communication device (16) in the physical toll station (4) contains data that identifies the vehicle (V1-V4) as well as data on the charge debited to the vehicle (V1-V4).

8. A method according to claim 7, **characterized in that** the signal that constitutes the receipt is encrypted.

9. A method according to claim 7, **characterized in that** the signal that constitutes the receipt is encrypted and contains a digital signature and a cryptographic check total.

10. A method according to claim 7, **characterized in that** the receipt also contains data on a category to which the vehicle (V1-V4) belongs.

11. A method according to claim 1 or 6, **characterized in that** the communication between the vehicle (V1-V4) and the central unit (C) is encrypted.

12. A method according to claim 1, **characterized in that** the respective passing vehicle (V1-V4) is identified in the physical toll station (4) by a correlation between the vehicle identity obtained by imaging and data supplied by the receipt.

13. A method according to claim 1, **characterized in that** communication (12) between the transmitter/ receiver (11) in the vehicle (V1-V4) and communication equipment (26) in the central unit (C) occurs via a cellular mobile transmitting network such as a GSM network.

14. A method according to claim 1, **characterized in that** communication (2) between the first communication device (1) in a vehicle (V1-V4) and the second communication device (16) in the physical toll station (4) occurs by means of one of the following carrier media: microwaves, UWB waves, ultrasound, infrared light, laser, ordinary light and inductive transmission.

15. A method according to claim 1, **characterized in that** in the vehicle equipment's storage unit (6) is stored the requisite information, such as tariffs for debiting of tolls and positions of virtual toll charging stations (7).

Patentansprüche

1. Verfahren zum automatischen Abbuchen von Mautgebühren für Fahrzeuge (V1-V4) auf Verkehrswegen oder in Verkehrszonen,
wo wenigstens eine virtuelle Mautstation (7) in Bezug zu einer körperlich vorhandenen Mautstation (4) geografisch vorherbestimmt ist, wo ein einzelnes Fahrzeug (V1-V4) mit Fahrzeugausrüstung ausgerüstet ist und die Fahrzeugausrüstung umfasst:

   - ein erstes Kommunikationsgerät (1) zur Kommunikation mit einer strassenseitigen Einheit (3) bei der körperlich vorhandenen Mautstation (4);
   - ein Sender/ Empfänger (11) zur Kommunikation (12) mittels eines zellularen Netzwerkes mit einer Zentraleinheit (C);
   - und einen ersten Prozessor (5), einer Speichereinheit (6) und ein Empfänger (8) für ein GNNS-System;

   wobei

   - der Empfänger (8) Signale liefert, aus welchen der erste Prozessor (5) die Position des Fahrzeuges (V1-V4) liest und den Eintritt des Fahrzeugs in die wenigstens eine Mautstation (7) erkennt durch Vergleich der gelesenen Fahrzeugposition mit den Positionen der virtuellen Mautstationen, Daten, die in der Speichereinheit gespeichert sind;
   - auf Entritt des Fahrzeugs (V1-V4) in die wenigstens eine Mautstation (7) kündigt der Sender/ Empfänger (11) an, mittels des zellularen Netzwerkes zur Zentraleinheit (C), dass eine Mautgebühren-Abbuchung durchzuführen ist;
   - die Zentraleinheit führt die Mautgebühren-Abbuchung für das Fahrzeug (V1-V4) durch;
   - die Zentraleinheit (C) übermittelt einen Empfangsnachweis über die Abbuchung zum Fahrzeug mittels des Senders/ Empfängers (11) zurück;
   - auf Eintritt in die körperlich vorhandene Mautstation (4) sendet das erste Kommunikationsgerät (1) zur strassenseitigen Einheit (3) den Empfangsnachweis als Beweis dafür, dass die korrekte Gebühr gezahlt wurde.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** in Verbindung mit der Mautgebührenabbuchung wenigstens eine Transponder-Identität und eine Angabe der Zeit vom Fahrzeug (V1-V4) an die Zentraleinheit (C) gesendet wird.

3. Verfahren nach Anspruch 2, **dadurch gekennzeichnet, dass** in Verbindung mit der Mautgebüh-

renabbuchung die Zentraleinheit (C) ein transponderidentitätsverbundenes Gerät belastet, welches eine Geldsumme enthält.

4. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** in Verbindung mit der Mautgebührenabbuchung wenigstens eine Fahrzeug-Identität oder Guthabenspeicher-Identität und eine Aussage über die Zeit vom Fahrzeug an die Zentraleinheit (C) gesendet werden.

5. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** in Verbindung mit der Mautgebührenabbuchung die Zentraleinheit (C) ein Gerät belastet, welches mit der Fahrzeugidentität verbunden ist oder mit der Guthabenspeicher-Identität verbunden ist und welches eine Geldsumme enthält.

6. Verfahren nach Anspfüchen 1-5, **dadurch gekennzeichnet, dass** der Empfangsnachweis, welcher von der Zentraleinheit (C) zum Fahrzeug (V1-V4) zur Speicherung in der Fahrzeugausrüstungsspeicherungseinheit (6) gesendet wurde, sowohl Daten enthält, die das Fahrzeug identifizieren, als auch Daten der erhobenen Mautbelastung für das Fahrzeug.

7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** der Empfangsnachweis, welcher vom Fahrzeug (V1-V4) zu einem zweiten Kommunikationsgerät (16) in der körperlich vorhandenen Mautstation (4) gesendet wurde, sowohl Daten enthält, die das Fahrzeug identifizieren, als auch Daten der erhobenen Mautbelastung für das Fahrzeug.

8. Verfahren nach Anspruch 7, **dadurch gekennzeichnet, dass** das Signal, welches die Empfangsnachweis darstellt, verschlüsselt ist.

9. Verfahren nach Anspruch 7, **dadurch gekennzeichnet, dass** das Signal, welches die Empfangsnachweis darstellt, verschlüsselt ist und eine digitale Signatur und eine kryptografische Total-Überprüfung enthält.

10. Verfahren nach Anspruch 7, **dadurch gekennzeichnet, dass** der Empfangsnachweis auch Daten enthält, zu welcher Kategorie das Fahrzeug (V1-V4) gehört.

11. Verfahren nach Anspruch 1 oder 6, **dadurch gekennzeichnet, dass** die Kommunikation zwischen dem Fahrzeug (V1-V4) und der Zentraleinheit (C) verschlüsselt ist.

12. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das jeweils passierende Fahrzeug (V1-V4) in der körperüch vorhandenen Mautstation (4) mittels einer Übereinstimmung zwischen der in einem bildgebenden Verfahren erhaltenden Fahrzeugidentität und den in dem Empfangsnachweis enthaltenden Daten identifiziert wird.

13. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** Kommunikation (12) zwischen dem Sender/ Empfänger (11) im Fahrzeug (V1-V4) und der Kommunikationsausrüstung (26) in der Zentraleinheit (C) mittels eines zellularen mobilen Übertragungsnetzwerks, wie ein GSM-Netzwerk, stattfindet.

14. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** Kommunikation (2) zwischen dem ersten Kommunikationsgerät (1) in einem Fahrzeug (V1-V4) und dem zweiten Kommunikationsgerät (16) in der körperlich vorhandenen Mautstation (4) durchgeführt wird durch eine der folgenden Trägermedien: Mikrowellen, UWB-Wellen, Ultraschall, Infrarot-Licht, Laser, normales Licht und Induktive Übertragung.

15. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** in der Fahrzeugsausrüstungsspeichereinheit (6) die notwendigen Informationen gespeichert sind, solche wie Tarife zur Gebührenabbuchung und Positionen von virtuellen Mautstationen (7).

Revendications

1. Procédé destiné à débiter automatiquement des frais de péage pour des véhicules (V1 à V4) sur des routes de circulation ou dans des zones de circulation,

où au moins un poste virtuel de paiement de frais de péage (7) est géographiquement prédéterminé par rapport à un poste de péage physique (4), où un véhicule respectif (V1 à V4) est équipé d'un équipement pour véhicule, ledit équipement pour véhicule comprenant :

- un premier dispositif de communication (1) pour une communication avec une unité située au bord de la route (3) au niveau dudit poste de péage physique (4) ;
- un émetteur/récepteur (11) pour une communication (12) via un réseau cellulaire avec une unité centrale (C) ; et
- un premier processeur (5), une unité de stockage (6) et un récepteur (8) pour un système GNSS ; moyennant quoi
- le récepteur (8) fournit des signaux à partir desquels le premier processeur (5) lit la position du véhicule (V1 à V4) et détecte l'entrée du véhicule dans l'au moins un poste virtuel de paie-

ment de frais de péage (7) en comparant la position du véhicule lue avec les positions des postes virtuels de paiement de frais de péage, dont les données sont stockées dans l'unité de stockage (6) ;

- lors de l'entrée du véhicule (V1 à V4) dans l'au moins un poste virtuel de paiement de frais de péage (7) l'émetteur/récepteur (11) annonce, via un réseau cellulaire, à l'unité centrale (C) qu'une transaction de débit de frais de péage va être exécutée ;
- l'unité centrale (C) effectue la transaction de débit de frais de péage pour le véhicule (V1 à V4) ;
- l'unité centrale (C) remet un reçu de la transaction de véhicule par son émetteur/récepteur (11) ;
- lors de l'entrée dans le poste physique de paiement de frais de péage (4), le premier dispositif de communication (1) envoie à l'unité (3) située au bord de la route, le reçu comme preuve que les frais de péage corrects ont été payés.

2. Procédé selon la revendication 1, **caractérisé en ce que** avec la transaction de débit de frais de péage au moins une identité du répondeur et un relevé du temps est envoyé depuis le véhicule (V1 à V4) à l'unité centrale (3).

3. Procédé selon la revendication 2, **caractérisé en ce que** avec la transaction de débit de frais de péage l'unité centrale (C) débite un dispositif associé à une identité du répondeur contenant une somme d'argent.

4. Procédé selon la revendication 1, **caractérisé en ce que** à propos de la transaction de débit de frais de péage au moins une identité de véhicule ou une identité de porte-monnaie et un relevé du temps sont envoyés à partir du véhicule à l'unité centrale (C).

5. Procédé selon la revendication 4, **caractérisé en ce que** à propos de la transaction de débit de frais de péage l'unité centrale (C) débite un dispositif associé à l'identité du véhicule ou l'identité du porte-monnaie, et contenant une somme d'argent.

6. Procédé selon les revendications 1 à 5, **caractérisé en ce que** le reçu qui est envoyé à partir de l'unité centrale (C) au véhicule (V1 à V4) pour être stocké dans l'unité de stockage (6) de l'équipement pour véhicule contient des données qui identifie le véhicule en plus de données sur les frais débités au véhicule.

7. Procédé selon la revendication 6, **caractérisé en ce que** le reçu qui est envoyé à partir du véhicule (V1 à V4) à un second dispositif de communication (16) dans le poste physique de péage (4) contient des données qui identifient le véhicule (V1 à V4) en plus de données sur les frais débités au véhicule (V1 à V4).

8. Procédé selon la revendication 7, **caractérisé en ce que** le signal qui constitue le reçu est crypté.

9. Procédé selon la revendication 7, **caractérisé en ce que** le signal qui constitue le reçu est crypté et contient une signature numérique et un total à contrôle cryptographique.

10. Procédé selon la revendication 7, **caractérisé en ce que** le reçu contient également des données sur une catégorie à laquelle le véhicule (V1 à V4) appartient.

11. Procédé selon la revendication 1 à 6, **caractérisé en ce que** la communication entre le véhicule (V1 à V4) et l'unité centrale (C) est cryptée.

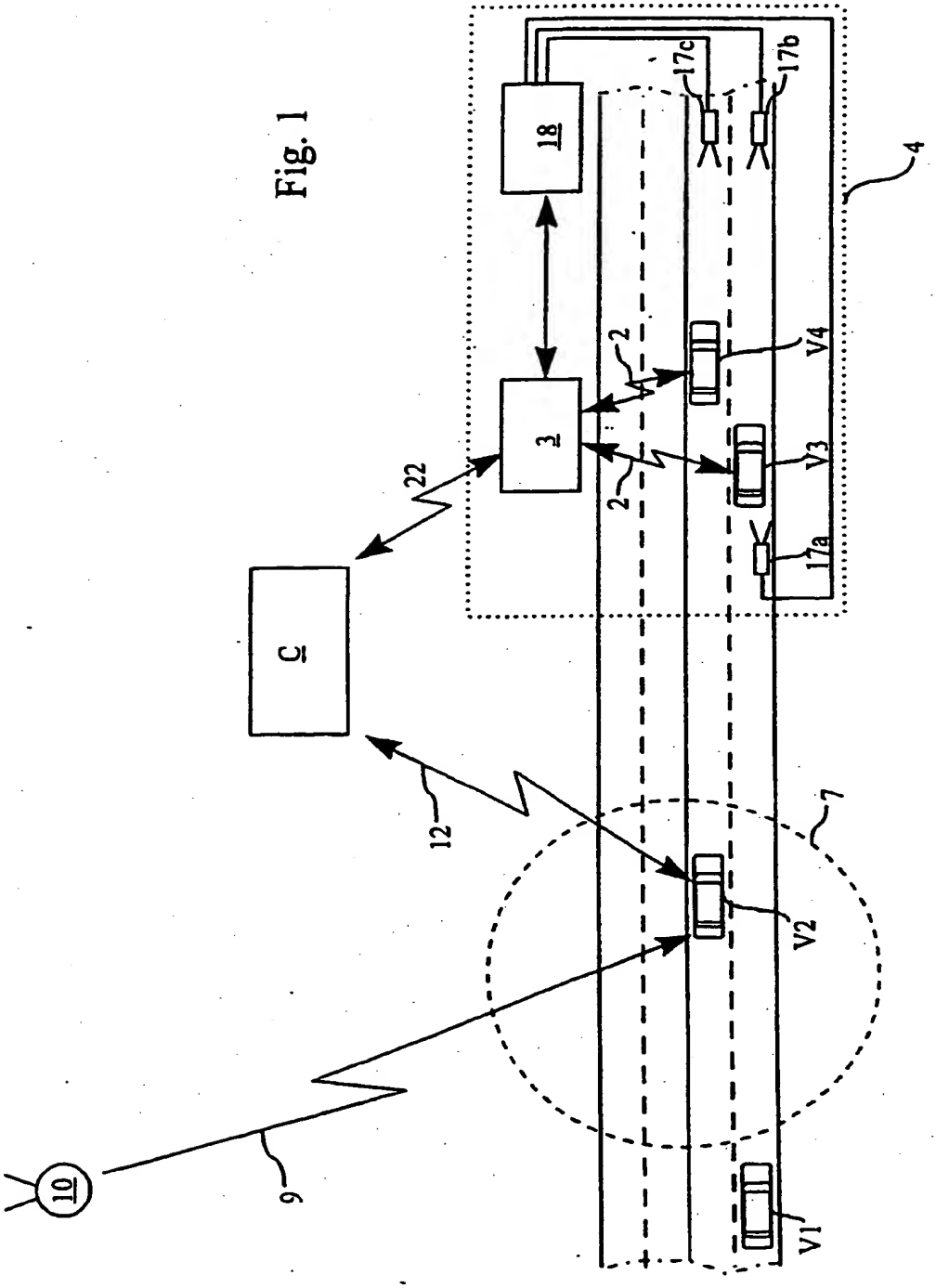
12. Procédé selon la revendication 1, **caractérisé en ce que** le véhicule de passage respectif (V1 à V4) est identifié dans le poste physique de péage (4) par une corrélation entre l'identité du véhicule obtenue par imagerie et des données fournies par le reçu.

13. Procédé selon la revendication 1, **caractérisé en ce qu'**une communication (12) entre l'émetteur/récepteur (11) dans le véhicule (V1 à V4) et un équipement de communication (26) dans l'unité centrale (C) survient via un réseau de transmission mobile cellulaire tel qu'un réseau GSM.

14. Procédé selon la revendication 1, **caractérisé en ce qu'**une communication (2) entre le premier dispositif (1) de communication dans un véhicule (V1 à V4) et le second dispositif (16) de communication dans le poste physique de péage (4) survient à l'aide de l'un parmi les moyens porteurs suivants : des micro-ondes, des ondes ULB (à bande ultralarge) ; des ultrasons, une lumière infrarouge, un laser, une lumière ordinaire et une transmission inductive.

15. Procédé selon la revendication 1, **caractérisé en ce que** dans l'unité de stockage (6) de l'équipement pour automobile sont stockées les informations requises, telles que les tarifs pour débiter des frais de péage et des positions des postes virtuels de paiement de frais de péage (7).

Fig. 1



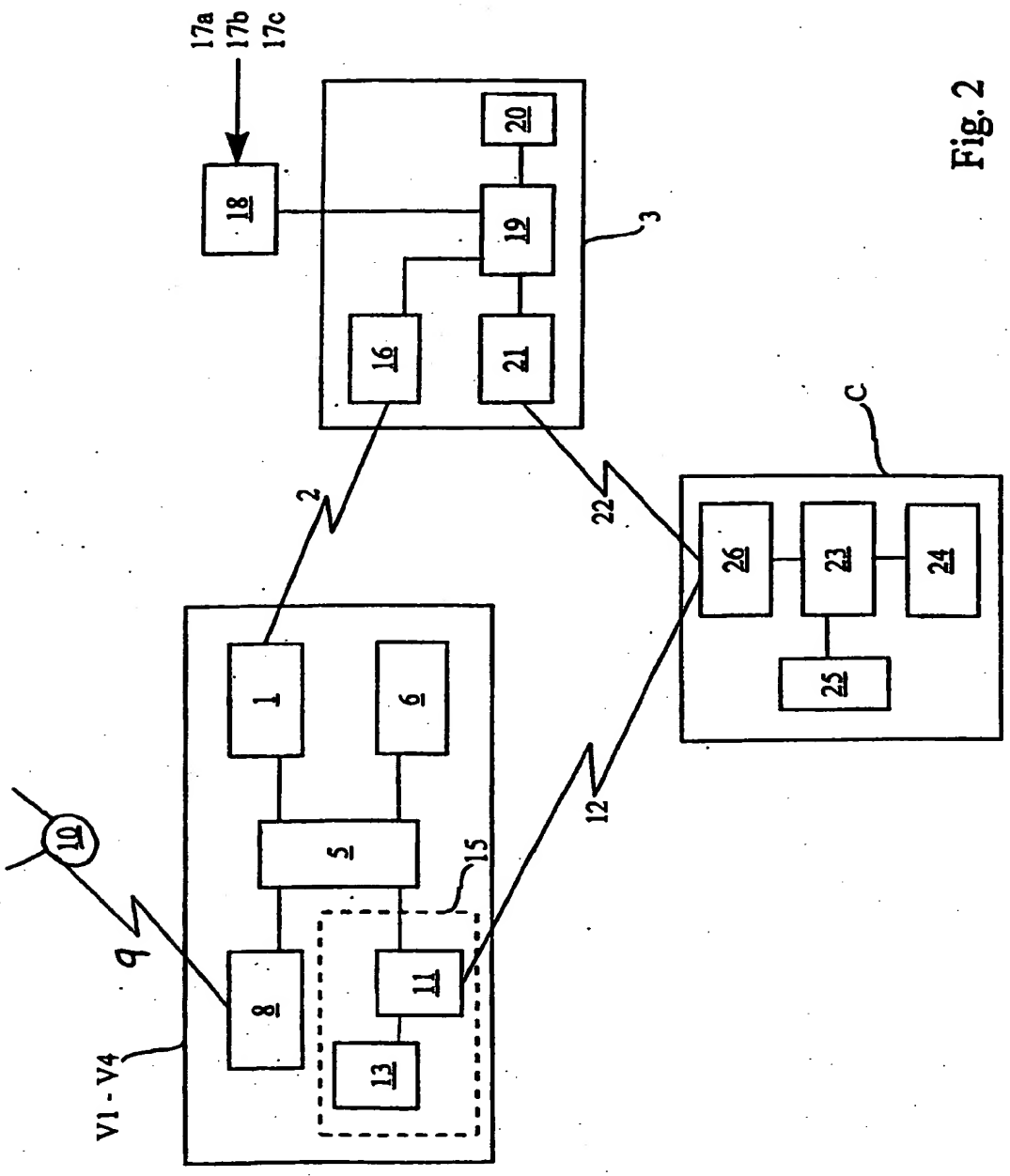


Fig. 2